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(54) MULTILAYER FELT BAND

(71) We, IRAPA VÝVOJOVÝ A RACIONALIZAČNÍ ÚSTAV PRŮMYSLU PAPÍRU A CELUOZY, a Czechoslovak Corporation of No 1 Přístavní, Praha, Czechoslovakia, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to felt bands and particularly felt bands as used in the paper making industry. The development of similar felt bands proceeded in recent years from the use of natural fibers to increasing application of synthetic fibers. The application of these fibers enabled development of new technological processes, for instance the technology of needling. The melting together of thermoplastic fibers equally belongs to these novel technological processes. The new synthetic materials brought particularly resistivity to abrasion, against the influences of different chemicals, mould and similar. These materials found their application particularly in the manufacture of felt bands in paper making for dewatering, dehumidifying and drying, for manufacture of materials for filtering and insulating and similar. In case of felt bands for the paper manufacture there are particularly needled felt bands, characterised by an internal structure where the supporting tissue or netting is connected with a needled fleece of not feltable fibers.

The supporting tissue serves here as supporting medium and as means for achievement of the required strength and stability of dimensions, whereby the loops of this supporting tissue can serve as storage spaces for the working medium, for instance water. This support is however from the point of view of some required properties unwelcomed. New types of felt bands have been therefore developed which have few or no wefts and recently even felt bands having practically no supporting tissue and represent a layer obtained by a fiber fleece reinforced by needling. The stability of dimensions and required strength of these materials is thereby obtained both by intensive needling and by chemical impregnation or melting together. By needling, bonds are formed in a fleece of not feltable fibers, which provide the strength of the fleece and which are connecting the individual layers of fiber fleeces together. The chemical impregnation of the felt band improves also the necessary strength and stability of dimensions. Internal bonds between thermoplastic fibers can be also created by their melting together in order to strengthen the structure of the felt band. These felt bands are spatially arranged so that the fibers are oriented in the plane of the surface of the felt band and the bonds are orientated in a direction substantially perpendicular to this plane. In case of a chemical working of the felt band bonds are created by bonding the fibres of the fleece by some synthetic resin in the whole structure of the felt band. Drawbacks of these methods of making felt bands are that no storage spaces for the working medium are provided and furthermore that they influence some of required properties as perviousness, strength, elasticity, clogging and similar.

According to the invention we provide a multilayer felt band comprising at least two layers of fibrous material containing thermoplastic material either as the material of some or all of the fibres or as an impregnant or coating for the fibres, wherein at least one of said layers is provided with a plurality of storage spaces on at least one major surface thereof, said storage spaces being formed by melting by means of a laser beam whereby the walls of the spaces are strengthened in the region of the fused defining walls thereof.

Further according to the invention we provide a process for manufacturing a multilayer felt band defined in the above statement of invention, comprising passing a first layer of fibrous material about a roll,

conveying a second layer of fibrous material in a direction to converge with said first layer in the region of the roll, directing a laser radiation beam towards said second layer, forming a series of storage spaces in a major surface of said second layer by melting the fibres with said radiation beam, and bringing said two layers together to form a unitary band.

The storage spaces in the form of channels in individual layers can be according to this invention interconnected, that is they may join mutually, creating thus in the felt band a continuous system of storage spaces promoting the dewatering. Channels of trapezoidal shaped cross section may widen conically toward the lower surface of the felt band. A thus made felt band can be very advantageously used where large amounts of water have to be removed. The invention includes however also a felt band, where storage spaces formed in individual layers of the felt band create a separate system i.e. they are not interconnected with storage spaces of adjacent layers. Such a felt band prevents a back-sucking on of water into the paper and is particularly advantageous to be used on the second and third press of a paper making machine and generally for slow operating paper making machines.

The storage spaces in the form of channels according to this invention are melted out in individual layers of the felt band by laser beams acting on the layer of the felt band at a certain angle. The melting out of storage spaces thereby takes place as the layer of the felt band is taken along by a rotating roll, possibly near the contact line between both rolls. Thus the melting out of the storage spaces is accomplished at dynamic conditions, in the course of compressing and extending the layer of the felt band and in the course of connection of layers. The rolls are thereby advantageously heated. This process leads to a creation of strong and elastic bonds between fibres at the place of their melting together, to a stronger and more elastic connection of layers and thus to a higher strength and stability of dimensions of the felt band. By selection of the distance of the place of action of the radiation beam on the layer of the felt band from the connecting line it is possible to influence to a certain degree the density of the structure of the wall of the storage space and thus the capability of storing of water by the felt band.

One or more devices for producing radiation beams (lasers) are used for forming the storage spaces in the felt band. The beams may act in the region of the connection line of connected layers either directly or by way of some layer. The number, situation and shape of the storage spaces is determined by the position and relative movement of a layer or layers of the felt band respectively and of corresponding radiation beam. These conditions are also controlled by a continuous or intermittent operation of the radiation devices and by applied rasters and diaphragms through which the beams pass. The diameter of the radiation beam can be adjusted by focussing.

In addition to already mentioned advantages, the invention solves also the problem of suitably orientated storage spaces for the working medium in the felt band, thereby substantially improving the efficiency of the felt band. The felt band according to this invention will have in addition to a higher elasticity and strength also a better stability of dimensions, it will be less clogged and in case of its application there will be a substantially lower return humidifying of the paper.

The method and arrangement for making felt bands according to this invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 is a cross section of a felt band with two layers,

Figure 2 is a side view showing the connecting of both layers and forming of storage spaces,

Figure 3 a cross section of a felt band with four layers,

Figure 4 the corresponding side view showing their connecting and forming of storage spaces,

Figure 5 a cross section of a felt band with two layers,

Figure 6 a corresponding axonometric view showing again the arrangement of storage spaces,

Figure 7 a cross section of a felt band with three layers,

Figure 8 the corresponding side view showing their connection and forming of storage spaces.

The felt band according to Fig. 1 and 2 has an upper layer 8*a* facing the paper and a lower layer 8*b*. Both layers are composed of a mixture of polyester and polyamide fibers in a ratio 1:2. The individual layers 8*a*, 8*b* have been made on a carding machine and prior strengthened by needling. The lower layer 8*b* of the felt band has storage spaces 9 of the shape of channels orientated at an angle 30° against the surface of the felt band. The channels are orientated parallel to the longitudinal axis of the felt band when viewed from above, and pass from the surface of the lower layer toward the center in direction of movement of the felt band. The channels are melted out of the lower layer 8*b* of the felt band by radiation generated by a

radiation beam from a laser 1 situated in front of the connecting line 7 of the connected layers 8*a*, 8*b* of the felt band so that the radiation beam impinges on the layer 8*b* of the felt band at the angle 30°. The beam acts on the moving layer 8*b* of the felt band through a rotating diaphragm 6 and performs simultaneously a transverse movement across the width of the felt band. The described felt band is particularly suitable to be applied on presses with full rolls.

The multilayer felt belt according to Fig. 3 and 4 is composed of four layers 8*a*, 8*b*, 8*c*, 8*d*. All layers are made of a mixture of polyester and polyamide fibres at a ratio 1 to 4. The storage spaces 9 of the shape of channels are orientated at an angle 45° against the surface of the felt band and are situated in both middle layers 8*c*, 8*d* of the felt band so that channels of one layer are at an angle 90° to channels of the other layer. The felt band is made so that both first layers 8*a*, 8*c* strengthened by needling are connected in the region of the connecting line 7 with the other two layers 8*d*, 8*b* equally prior strengthened by needling. As seen in Figure 4 the beams generated by two lasers 1*a*, 1*b* situated in front of the connecting line 7 act on the layers through a rotating diaphragm 6. The beams generated by both generators cross.

The multilayer felt band according to Fig. 5 and 6 is composed of an upper layer 8*a* and a lower layer 8*b*. Both layers are made of polyamide fibres. The lower layer 8*b* represents about one third of the thickness of the felt band. The individual layers of the felt band are made on a carding machine and have been prior strengthened by needling. At the boundary of the upper layer 8*a* and the lower layer 8*b* storage spaces 9 of the shape of elongate chambers are provided which are parallel with the axis of the felt band in the longitudinal direction so that they form parallel rows, the channels of each row are mutually separated by gaps. The chambers communicate with the natural interfibrous capillary system of the layers so that they receive the media (water) from the processed material.

The multilayer felt band according to Figures 7 and 8 is composed of three layers 8*a*, 8*b*, 8*c*. Each layer contains a mixture of polyester and polyamide fibres at the ratio 1 to 3 and is strengthened by needling. The upper layer 8*a* is provided with storage spaces 9 of the shape of channels orientated at the angle 60° against the surface of the layer whereby the channel passes from the surface of the felt band toward its center in direction of the supposed movement of the felt band in the paper making machine. The middle layer 8*c* of the felt band is provided with storage spaces 9 of the shape of channels perpendicular to the surface of the layer. The lower layer 8 is provided with storage spaces 9 of the shape of channels orientated at the angle 10° against the surface of the layer, whereby the channel passes from the surface of the felt band toward its center against the supposed direction of movement of the felt band in the paper making machine. The supposed direction of movement of the felt band is indicated in the drawing by an arrow. The channels in the individual layers 8*a*, 8*c*, 8*b* have different diameters, which are at the ratio 1 to 2 to 4 (from the upper to the lower layer). The felt band is made of the individual layers so that the upper layer 8*a* and the middle layer 8*c* are guided toward the connecting line 7 between two rolls 5*a*, 5*b*. Two lasers 1*a*, 1*b*, are situated in front of the connecting line 7ª so that the beam generated by laser 1a is with the surface of the upper layer 8a at the angle 60° and the beam generated by laser 1b with the middle layer 8*c* at the angle 90°. To thus arranged layers the lower layer 8*b* of the felt band is joined at the connecting line 7*b* and the laser 1c situated above this layer acts with its radiation beam in the region of the connecting line 7ᵇ, whereby this radiation beam is at the angle 10° to the lower layer 8*b*. The radiation beams generated by lasers 1*a*, 1*b*, 1*c* pass through rotating diaphragms 6*a*, 6*b*, 6*c* whereby the respective part of the laser enables a movement of the beam along the whole width of the felt band, The thus made felt band is particularly suitable for removal of large amounts of water.

The multilayer felt band according to Fig. 9 and 10 is composed of two layers 8*a* and 8*b*. Both layers consist of polyamide fibers. The lower layer 8*b* is provided with storage spaces 9 of the shape of channels with trapezoidal cross section with an axis perpendicular to the surface of the felt band. The upper layer 8a and the lower layer 8*b* are thereby interconnected by storage spaces 9 of the shape of channels perpendicular to the surface of the felt band.

The channels 9 in the lower layer 8*b* are conically widen, so that their walls are against the surface of the felt band at an angle different from 90°. These channels have been made at dynamic conditions at the connecting line 7, securing thus their stable elastic wall. The connecting line 7 is determined by two rolls 3*a*, 3*b* provided with mantles 4*a*, 4*b* with openings. A reflecting mirror 2*a* is situated inside the roll 3*a* and a reflecting mirror 2*b* inside the roll 3*b*. The storage spaces 9 have been melted out in the lower layer 8*b* at dynamic conditions by a laser 1*b* being situated near the roll 3*b*. The radiation of laser 1*b* passes

through a diaphragm $6b$. The storage spaces 9 of the shape of channels interconnecting the upper layer $8a$ and the lower layer $8b$ have been melted out at the connecting line 7 by radiation generated by the laser $1a$ situated at the roll $3a$ via a rotating diaphragm $6a$.

WHAT WE CLAIM IS:—

1. A multilayer felt band comprising at least two layers of fibrous material containing thermoplastic material either as the material of some or all of the fibres or as an impregnant or coating for the fibres, wherein at least one of said layers is provided with a plutality of storage spaces on at least one major surface thereof, said storage spaces being formed by melting by means of a laser beam whereby the walls of the spaces are strengthened in the region of the fused defining walls thereof.

2. A multilayer felt band as claimed in claim 1, wherein the storage spaces in at least one layer are of trapezoidal cross section.

3. A multilayer felt band as claimed in claim 1 or 2, wherein said storage spaces are substantially elongate holes which lie parallel to (0°), at right angles to (90°) or at any desired angle of inclination between 0° and 90° relative to the plane of the belt.

4. A process for manufacturing a multilayer felt band as claimed in claim 1, comprising passing a first layer of fibrous material about a roll, conveying a second layer of fibrous material in a direction to converge with said first layer in the region of the roll, directing a laser radiation beam towards said second layer, forming a series of storage spaces in a major surface of said second layer by melting the fibres with said radiation beam, and bringing said two layers together to form a unitary bond.

5. A process as claimed in claim 4, wherein said radiation beam is directed obliquely of said major surface of said second layer.

6. A process for manufacturing a multilayer felt band as claimed in claim 1, comprising passing a first layer of fibrous material about a first hollow roll, passing a second layer of fibrous material about a second hollow roll disposed adjacent said first roll, said first and second layers passing towards said two rolls in converging manner, directing laser radiation beams towards said two layers respectively in the converging region of the two layers, forming a series of storage spaces in each of a major surface of said first and second layers by melting the fibres with said radiation beams, and passing said two layers between the two rolls to bring said layers together to form a unitary band.

7. A process as claimed in claim 6, wherein said beams are of different diameters whereby said storage spaces in one layer are of different sizes to those in the other layer.

8. A process for manufacturing a multilayer felt band as claimed in claim 1, comprising passing a first layer of fibrous material about a first roll, passing a second layer of fibrous material about a second roll disposed adjacent said first roll, said first and second layer passing towards said two rolls in converging manner, providing mirrors within said rolls, forming a series of storage spaces in said two layers by directing laser radiation beams through apertures provided in the walls of said rolls and reflecting the beam by said mirrors onto said layers via said apertures in regions which are contacted by said layers.

9. A process as claimed in claim 8, wherein one of the beams is directed towards a region of one layer in a region where said layer commences a linear run to form storage spaces extending at right angles to the length of the belt.

10. A process as claimed in claim 9, wherein the other of said beams is directed towards a region of the other layer where the other layer is deformed about its roll to form storage spaces having trapezoidal form extending across said layer.

11. A multilayer felt band substantially as described herein with reference to the accompanying drawings.

12. A process for manufacturing a multilayer felt band substantially as described herein with reference to the accompanying drawings.

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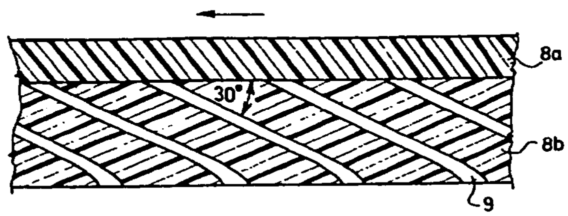

FIG. 1

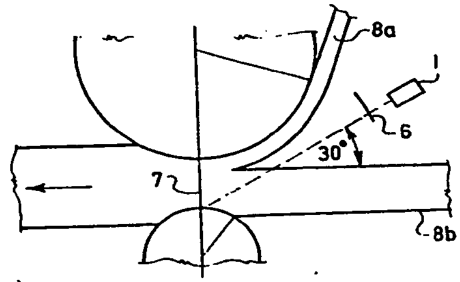

FIG. 2

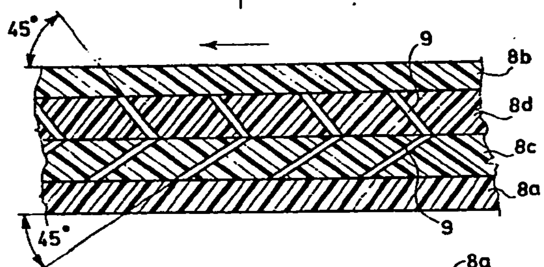

FIG. 3

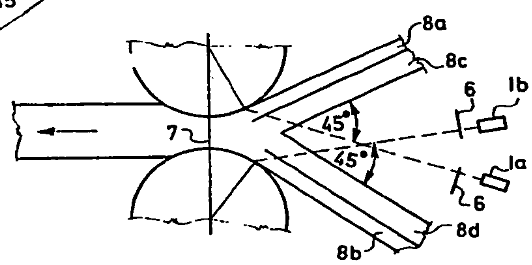

FIG. 4

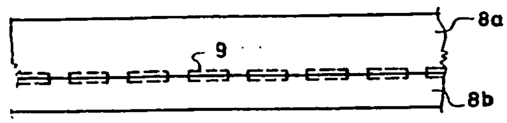

FIG.5

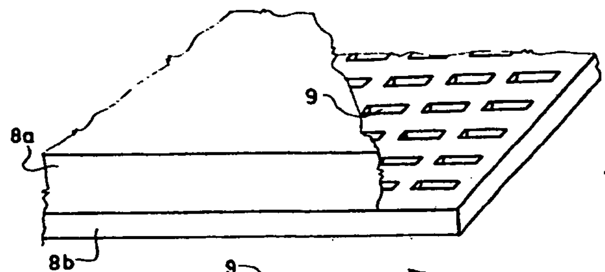

FIG.6

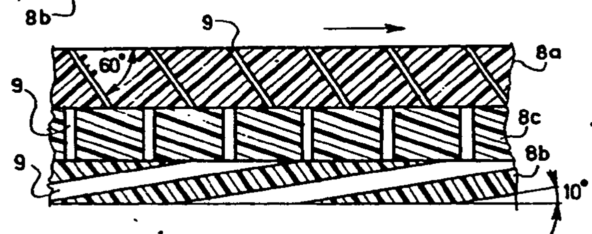

FIG.7

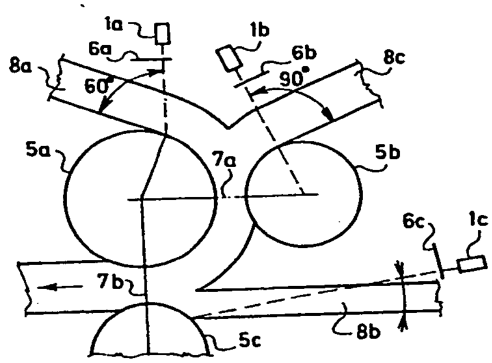

FIG.8

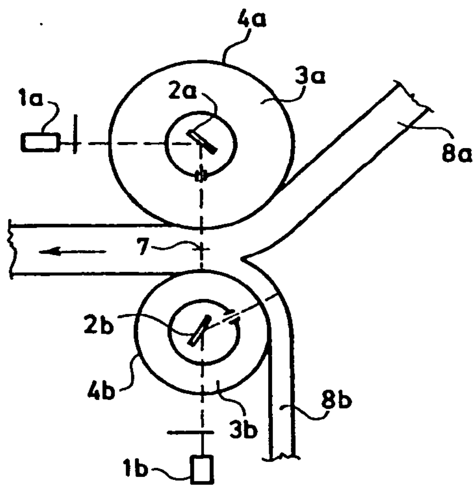

FIG. 9

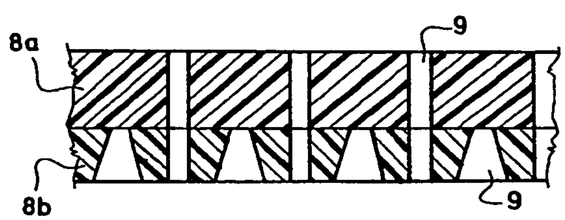

FIG. 10